THE LIMING OF SOILS

A radio talk by Dr. E. C. Shorey, Bureau of Chemistry and Soils, delivered through WRC and 39 other stations associated with the National Broadcasting Company, March 3, 1931.

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Since this country was first settled, farmers have been applying lime to its soils for the purpose of increasing crop yields. Liming has been followed in many parts of Europe for centuries, and dates back more than 3,000 years.

So we are not talking today about a new farming practice. We are simply trying to get at the modern principles of soil liming. We shall try to outline the fundamental facts you need to take into account in deciding whether to apply lime to your land and what form to apply.

Your decisions on these points depend upon the kind of liming material available, your soil, and your crops. We shall take up each of these points in their turn.

Liming means simply applying to the soil the element known to the chemist as calcium. It may be applied in one of two forms--either calcium carbonate, more commonly known as carbonate of lime, or calcium oxide, the ordinary burned lime of commerce.

Carbonate of lime occurs in nature in several forms. Ordinary limestone is the most common. Less common forms are marble, chalk, marl, coral, and oyster and clam shells. Any of these forms, properly prepared, is suitable for farm use.

You buy limestone for agricultural use either as ground limestone, pulverized limestone, or perhaps, under proprietary or trade names that do not indicate its composition. Now one important thing to know about limestone is that it varies in content of carbonate from 95 per cent or more to as low as 60 per cent. Unless your land is close to the limestone deposit, you probably will not find it economical to use limestone containing less than 80 to 85 per cent of carbonate.

Another thing you should know about limestone is that magnesium limestone is equal in value to ordinary limestone. Magnesium limestone is also sometimes called "dolomitic limestone." At one time a prejudice against its use existed.

I shall not have time to give you further facts about the less common types of carbonate of lime -- marble, marl, chalk, coral, and oyster and clam shells. I do want to pause here long enough, however, to point out that you may be able to get in your locality industrial waste products containing oxide or lime or lime carbonate. I mean such substances as lime from gas works, paper mills, tanneries, water-softening processes, spent calcium carbide, and slags from iron

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and other works. I mention these because you need to observe caution in using them. They may contain compounds injurious to vegetation. Make sure they are free from such compounds before you use them.

Now about oxide of lime. This, too, you are able to buy in several forms. All of them are derived from some form of lime -- almost always carbonate -- by heating or burning. The oxide of lime will be just as pure as the limestone from which it is made. The burning only drives off a gas.

The first step in preparing oxide of lime is to burn lumps of limestone. The burned lime retains the lump form. You may know it either as "burned lime," "quick lime," "caustic lime," "lump lime," or "builders' lime."

Originally, this lump lime, just as it came from the kiln with all of the unburned and overburned lumps in the batch, was called "agricultural lime." Now, however, the tendency is to use the name "agricultural lime," for any form of lime used for agricultural purposes.

The next step is either to grind or slake these lumps. You may buy for farm use the so-called "ground lime," which is simply burned lime finely ground.

Or you may buy the product made by slaking the burned lime. This is usually known as "hydrated lime." Sometimes it is called slaked lime, calcium-hydroxide, or lime hydroxide. Under whatever name you buy it, you get a finely divided product, necessarily of high grade because in the process all unburned lumps or overburned lumps are rejected.

Now there are the forms of lime, generally speaking, that are available to you for use on your soils. I know that because of local market or other conditions you may be limited to one form of lime. That is, because of the expense of freight and so on, some forms cost too much for you to use them economically.

But if you do have a choice, it usually lies between some form of carbonate of lime or oxide of lime. These are the facts that you need to consider in choosing the form to use on your land!

In the first place, all forms of ground or pulverized carbonate of lime are approximately alike if their purity is the same and they are ground to the same degree of fineness. The practical application of this fact is that you will profit by choosing between two samples of the same purity the more finely ground specimen; between two samples of the same fineness the one containing the highest percentage of carbonate or, in the case of magnesium limestone, the one containing the highest percentage of carbonate of lime and magnesia.

Secondly, all forms of slaked lime are of about the same fineness. The choice between samples of slaked lime depends on the purity, that is to say, the content of oxide of lime or lime and magnesia.

Thirdly, here is a rule to apply in choosing between lime carbonate and oxide of lime: fifty-six pounds of oxide of lime will give you the same chemical effect as 100 pounds of carbonate; and 74 pounds of hydrated lime will give the same effects as 100 pounds of carbonate.

One further consideration about ground limestone, I think I should give you. This is that it is not possible at reasonable cost to grind limestone so that it is as fine as slaked lime. This fact has led to the proposals for standards or specifications regarding fineness of ground limestone, since, to be immediately effective, ground limestone must contain a considerable proportion of fine material. Hence the specifications usually require that a fair percentage shall pass the meshes of a specified screen or sieve. A requirement that all shall pass a 10-mesh sieve is commonly regarded as satisfactory. Limestone ground or pulverized to such fineness will contain sufficient fine material immediately available and the coarser materials will become available before it is lost from the soil by leaching.

That latter point brings us to considering the second of the three fundamentals of applying limestone -- the soil.

Practically all crop-producing plants require that lime be present in some form in the soils where they grow. As a matter of fact, lime does occur in all soils. But it occurs in different forms and combinations, some only slightly soluble so that they dissolve in the soil water very slowly.

The carbonate of lime dissolves more readily than the other forms. It leaches from the soil in the drainage water. The soils of the Eastern, Southern, and some of the Central States have leached out until they contain only traces of carbonate of lime.

Then there are the acid soils to which we apply lime for the purpose of neutralizing the acid. The quantity of lime that must be added to a soil to bring about a neutral reaction is known as the "lime requirement" of that soil. This requirement is usually stated in pounds of lime oxide required for an acre of soil to a depth of 6 inches, or some other stated depth. All the methods for determining the lime requirement require laboratory equipment and none of them gives anything but an approximate figure.

A third sort of soil on which lime is beneficial is the heavy, compact type on which liming brings about better aeration and drainage.

On these and on other soils lime exerts the further beneficial effect of speeding up the decomposition of organic matter, thus bringing about conditions favorable to growing plants. Bear in mind, please, that all of the effects of liming may operate in the soil at the same time, and that probably in but few cases are the benefits resulting from liming due to lime alone.

Now for the practical application of these principles of soil in relation to liming.

You will lime peats, muck soils, and nearly all soils devoid of carbonate of lime and poorly drained for the purpose of correcting acid conditions which are almost sure to be present in such soils. To accomplish your purpose you probably will have to put on a large application.

You will lime a heavy, compacted soil to lighten it and allow aeration and better drainage. If such a soil is not acid comparatively smaller applications will do the work.

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Now for the purpose of stimulating the decomposition of organic matter, any application of lime, however small, will be of service. But remember this caution: do not apply lime in any form to soils deficient in organic matter, especially in warm, humid climates, without taking steps to put organic matter into the soil to keep up, or, if possible, increase, the supply of this essential ingredient.

Our third fundamental consideration in liming is the crop.

Leguminous plants, as you know, take large amounts of lime from the soil. Furthermore, many legumes do not grow well under acid soil conditions. This is particularly true of alfalfa and red clover, and perhaps to a less degree of sweet clover and vetch. On the other hand, cowpeas and soy beans usually do not respond to liming, and white clover grows well on acid soils.

Corn is usually considered to be tolerant of acid conditions. Such grasses as redtop, Bermuda, and lespedeza grow well on acid soils. Bog plants such as blueberries and cranberries require an acid soil, and such fruits as strawberries and raspberries apparently are not benefited by applications of lime.

The great majority of garden and truck crops and cereals usually are benefited by liming. But remember that different soils may require lime for different reasons; one for correction of acidity, another for improvement of drainage or to supply lack of lime. Then it becomes clear that a crop that responds to liming on one soil may not do so on another.

So the best advice that I can give you, sitting here in Washington, is that you experiment with your own soil to determine the response to liming with different crops.

Consult with your County Agent, or with the soils men of your State Agricultural Experiment Station. These men are familiar with local conditions and can give you sound directions. If you wish to study the principles of soil liming, we shall be glad to send you a copy of Farmers' Bulletin No. 921-F which is entitled "The Principles of the Liming of Soil."
